THERMOSTATIC MIXING VALVE

FIELD OF THE INVENTION

The present invention relates to a thermostatic mixing valve.

BACKGROUND OF THE INVENTION

Thermostatic mixing valves enable hot and cold fluids, typically water, to be accurately mixed so as to deliver fluid at a desired temperature to the valve outlet. One form of thermostatic mixing valves adopts a "T" pattern in which the hot and cold water enters through inlets in the arms of the "T" and the mixed water exits through an outlet in the base of the "T". Another form of thermostatic mixing valve adopts an "L" pattern in which the hot and cold fluid inlets are orientated at right angles to each other.

Thermostatic mixing valves include hot and cold seats for respectively isolating the flow of hot and cold fluids through the valve. Such seats are typically provided by a hard edge of a piston pressing firmly against a flat face of the valve body to thereby prevent fluid flow. In one form of "T" pattern mixing valves, both the hot and cold seats have been provided in this manner. However, the design of such mixing valves has been complicated by the need to provide a mechanism for allowing for any continued expansion of the thermostatic element after the flow of hot and cold fluids is adjusted. This problem has been addressed by including a spring arrangement adjacent to the leading end of the thermostatic valve (i.e. in the hot seat). The inclusion of such an arrangement requires an extra opening to be formed in the valve body and also increases the part and production costs for the valve.

Another problem with such mixing valves is that to enable adjustment of the set temperature of the mixed water exiting the outlet (and thereby the rest position of the thermostatic element), additional constructional features or components have to be provided. This inevitably increases the cost of the mixing valve.

The present invention seeks to provide an improved thermostatic mixing valve that addresses at least some of the above mentioned problems.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a thermostatic mixing valve including a valve body having a first fluid inlet, a second fluid inlet and a fluid outlet, a mixing chamber located between the respective fluid inlets and the fluid outlet, a thermostatic element located in or adjacent to the mixing chamber, a piston arranged for movement within the valve body in response to the thermostatic element, said piston arranged to throttle the flow of the first fluid into the mixing chamber by varying its position relative to a first fluid seat, said piston also arranged to throttle the flow of the second fluid into the mixing chamber by varying its position relative to a second fluid seat and wherein the second fluid seat is configured to allow for movement of the piston as a result of continued expansion of the thermostatic element.

Preferably, the second fluid seat is formed as an elongate portion extending in the direction of the movement of the piston so as to allow the piston to slide along the elongate portion to thereby allow for continued expansion of the thermostatic element.

In accordance with one embodiment of the invention, the elongate portion is formed on the valve body and an outer peripheral wall of the piston slides along the elongate portion.

In accordance with another embodiment of the invention, the elongate portion is formed on a member located within the valve body and an inner peripheral wall of the piston slides along the elongate portion.

The first fluid seat is preferably formed in a portion of the valve body.

An adjustment mechanism may be provided to adjust the positioning of the thermostatic element relative to the piston so that a set temperature of the fluid through the fluid outlet can be varied.

Preferably, adjustment of the adjustment mechanism results in a change in the flow of fluid from the respective hot and cold fluid inlets into the mixing chamber so that the set temperature of the fluid flowing through the fluid outlet is adjusted.

In one preferred arrangement, a mixing tube is configured to seat a trailing end of the thermostatic element, whilst a leading end of the thermostatic element is arranged to contact a portion of the piston. The adjustment mechanism may include a thread arrangement formed on the periphery of the mixing tube which is arranged to engage with a thread formed in the sidewall of the mixing chamber. Such a thread arrangement enables the mixing tube's positioning within the mixing chamber to be adjusted relative to the piston by rotating the mixing tube.

Alternatively, the adjustment mechanism may enable the size of the mixing tube to be varied so that it can be located in one of a series of seats formed in the sidewall of the mixing chamber.

With either arrangement, adjustment of the adjustment mechanism preferably takes place during manufacture or installation of the thermostatic mixing valve via access through the fluid outlet.

According to a further aspect of the invention there is provided a thermostatic mixing valve including a valve body having a first fluid inlet, a second fluid inlet and a fluid outlet, a mixing chamber located between the respective fluid inlets and the fluid outlet, a piston arranged to regulate the flow of the first and second fluids from their respective inlets into the mixing chamber, a thermostatic element located in or adjacent to the mixing chamber and an adjustment mechanism for adjusting a rest position of the thermostatic element.

Preferably, the adjustment mechanism includes an adjustment pin. The adjustment pin is threadedly connected to the valve body of the thermostatic mixing valve. The adjustment pin is configured so that an inner portion of the pin is in contact with the trailing end of the thermostatic element and an outer end of the pin is accessible from the outside of the valve body thereby enabling movement of the pin. The pin is configured so that movement thereof, for example rotation, results in an adjustment in the positioning of the thermostatic element relative to the piston.

In a preferred forms of either aspects of the invention, a check valve is mounted adjacent each of the hot and cold fluid inlets to prevent back flow of fluid through the respective inlets.

Preferably, the first fluid inlet is a cold fluid inlet and the second fluid inlet is a hot fluid inlet.

The present invention also provides a method of adjusting the temperature of an outlet fluid through a thermostatic valve, said thermostatic valve including a valve body having a first fluid inlet, a second fluid inlet and a fluid outlet, a mixing chamber located between the respective fluid inlets and the fluid outlet, a piston arranged to regulate the flow of the first and second fluids from their respective inlets into the mixing chamber, a thermostatic element located in or adjacent to the mixing chamber and an adjustment mechanism for adjusting the rest positioning of the thermostatic element relative to the piston, said method including the step of adjusting the adjustment mechanism so as to adjust the rest position of the thermostatic element relative to the piston to thereby change the flow of the first and second fluids into the mixing chamber until the temperature of the outlet fluid through the fluid outlet is at a desired set temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a cross sectional view of a thermostatic mixing valve in accordance with a first embodiment of the invention;

Figure 2 is a cross sectional view of a thermostatic mixing valve in accordance with a second embodiment of the invention;

Figure 3 is a cross sectional view of the thermostatic mixing valve shown in Figure 2 at 90° rotation; and

Figure 4 is a cross section view of a thermostatic mixing valve in accordance with a third embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 illustrates a thermostatic mixing valve 10 in accordance with an embodiment of the invention. The valve 10 includes a valve body 12, a cold fluid inlet 14, a hot fluid inlet 16 and a mixed fluid outlet 18. As is evident from Figure 1, the cold fluid inlet 14 and the hot fluid inlet 16 are orientated in an "L" shape so that the cold and hot fluid inlets 14, 16 are orientated at right angles to each other.

Located within the valve body 12 adjacent to each of the cold and hot fluid inlets 14, 16 is a respective check valve 20. Each check valve 20 is arranged to prevent inadvertent backflow of fluid through the respective cold and hot inlets 14, 16. It will be appreciated that although it is desirable to include such a check valve 20 adjacent each of the cold and hot inlets 14, 16 it is not essential to a proper working of the thermostatic mixing valve 10.

Located between the respective cold and hot fluid inlets 14, 16 is a regulating piston 22. The piston 22 is located within the valve body 12 and is configured

so that it can regulate, that is throttle, the flow of cold and hot fluid from their respective cold and hot fluid inlets 14, 16 into a mixing chamber 24. A thermostatic element 26 is located in the mixing chamber 24 between a mixing tube 28 and the piston 22. The mixing tube 28 is arranged to direct the flow of hot and cold fluid onto the thermostatic element 26. An adjustment mechanism, which will be described in more detail below, is formed as part of the mixing tube 28 and is arranged so that upon adjustment thereof, the mixing tube 28 moves in a direction towards or away from the hot fluid inlet 16, thereby adjusting the rest position of the thermostatic element 26. A change in the rest position of the thermostatic element 26, results in a change in the positioning of the piston 22. This in turn results in a change in the set flow of fluid from the respective cold and hot fluid inlets 14, 16 into the mixing chamber 24. This change in hot and cold fluid flow, results in the set temperature of the fluid flowing through the fluid outlet 18 being adjusted. The manner by which the flow of fluids from the respective cold and hot inlets 14, 16 to the mixing chamber 24 is varied by the piston 22 will be described in more detail below.

The piston 22 includes a bore 22a for housing a spring 34. The spring 34 is located about the periphery of a socket 36 which is formed in the piston 22 so as to receive a leading end 26a of the thermostatic element 26. The piston 22 has a first end 22b which is adjacent the hot inlet 16 and a second end 22c which is adjacent the cold inlet 14.

A seal 38, in the form of at least one O-ring, is located in a groove formed in the valve body 12 to provide a seal between the outer peripheral wall of the piston 22 and the valve body 12. The use of other forms of seal is envisaged.

Mounted in the valve body 12 is a valve member 44. The first end 22b of the piston 22 and the periphery of the member 44 define a flow path through which hot fluid can pass through the bore 22a of the piston 22 and into the mixing chamber 24. Flow of hot fluid through the piston 22 is throttled when the first end 22b of the piston 22 approaches the member 44. Flow of hot fluid through

the piston will be prevented when the first end 22b comes into sliding contact with the member 44. This contact defines the "hot seat".

The second end 22c of the piston 22 is configured to engage against a seat 46 formed in the sidewall of the valve body 12 of the thermostatic valve 10. For ease of further description, the seat 46 will be referred to hereafter as the "cold seat" 46. The second end 22c of the piston 22 and the cold seat 46 define a flow path through which cold fluid can pass from the cold inlet 14 into the mixing chamber 24. Flow of cold fluid into the mixing chamber 24 from the cold inlet 14 is throttled as the second end 22c of the piston 22 moves towards the seat 46. Cold fluid flow into the mixing chamber 24 will be prevented when the second end 22c of the piston 22 is located firmly against the cold seat 46 formed in the valve body 12. The spring 34 is biased to push the second end 22b of the piston onto the cold seat 46 and to balance the force of the thermostatic element 26.

In accordance with the embodiment shown in Figure 1, the mixing tube 28 includes a socket or seat 50 which is arranged to receive a trailing end 26b of the thermostatic element 26. Thus, as depicted in Figure 1, the thermostatic element 26 is located between and in contact with both the mixing tube 28 and the piston 22.

In the arrangement shown in Figure 1, the adjustment mechanism takes the form of a screw thread 52 formed on the outer periphery of the mixing tube 28. The screw thread 52 is arranged to engage with a corresponding thread formed on the internal wall of the valve body 12. Accordingly, when the mixing tube 28 is rotated along the thread, the positioning of the mixing tube 28 and the connected thermostatic element 26 is adjusted in a direction towards or away from the hot inlet 16. When the positioning of the thermostatic element 26 is adjusted there is an adjustment in the positioning of the piston 22. For example, if the mixing tube 28 and the connected thermostatic element 26 are adjusted so as to move them towards the hot inlet 16, the piston 22 will also be moved towards the hot inlet 16. Thus, the second end 22c of the piston 22 will

be moved away from the cold seat 46, allowing an increase in the flow of cold fluid from the cold fluid inlet 14 into the mixing chamber 24. At the same time there will be a decrease in the flow of fluid through the path defined between the first end 22b of the piston 22 and the member 44 and thus there will be a decrease in the flow of hot fluid into the mixing chamber 24. This will result in a reduction in the set temperature of the mixed fluid exiting the fluid outlet 18.

From the above description it will be appreciated that during manufacture or installation of the thermostatic mixing valve 10 it is possible to adjust the positioning of the mixing tube 28, thereby adjusting the rest position of the connected thermostatic element 26. This will result in an adjustment to the set temperature of the mixed fluid exiting the fluid outlet 18 during use thereof.

During use of the thermostatic mixing valve 10, cold fluid will enter the cold inlet 14 and hot fluid will enter the hot inlet 16. Unless the piston 22 is positioned to close off one of the hot or cold fluid paths, both hot and cold fluid will enter the mixing chamber 24 to surround the thermostatic element 26 and then exit through the outlet 18. Depending on the temperature of the mixed fluid within the mixing chamber 24, the thermostatic element 26 will either remain as it is, expand or contract. If the temperature of the fluid contacting the thermostatic element 26 is at the desired set temperature, the thermostatic element 26 will remain as it is and there will be no adjustment in the flow of hot and cold fluids into the mixing chamber 24. If the temperature of that fluid is too hot, the thermostatic element will expand so as to cause the piston 22 to move in a direction towards the hot inlet 16 against the bias of the spring 34. This will result in the second end 22c of the piston 22 moving away from the cold seat 46 and thus the flow of cold fluid into the mixing chamber 24 will increase. At the same time there will be a reduction in the flow of hot fluid through the fluid path defined by the first end 22b of the piston 22 and the member 44. Accordingly, this will result in the temperature of the mixed fluid within the mixing chamber 24 being reduced.

If the thermostatic element 26 continues to expand despite the increase of cold fluid into the mixing chamber 24, the piston 22 can continue to move within the bore of the valve body 12 by virtue of a sliding engagement with a peripheral portion of the member 44. The peripheral portion of the member 44 is an elongate portion that extends in the direction of the movement of the piston 22. It will thus be appreciated by those skilled in the art that this arrangement of the piston 22 and elongate portion of the member 44 provides a “slide through” hot seat configuration. By virtue of this "slide through" hot seat configuration, continued expansion of the thermostatic element 26 can be accommodated to a limited degree without damage to the valve 10.

If the temperature of the fluid contacting the thermostatic element 26 is too cold, the thermostatic element 26 will contract and there will be an increase in the flow of hot fluid and a decrease in the flow of cold fluid into the mixing chamber 24.

It will be appreciated that the thermostatic element 26 will continuously react (i.e. expand or contract) to the temperature of the fluid in the mixing chamber 24. As a consequence of this reaction, the piston 22 will continue to move within the bore of the valve body 12 so as to regulate the flow of cold and hot fluids into the mixing chamber 24. In this manner, the thermostatic mixing valve 10 will act to control the temperature of the fluid exiting the fluid outlet 18 to the set temperature. Provided the temperature of the cold and hot fluids entering the respective cold and hot inlets 14, 16 is reasonably constant, the positioning of the piston 22 relative to the cold and hot seats will eventually be stabilized.

Figures 2 and 3 illustrate a second embodiment of the invention. In this embodiment, the thermostatic mixing valve 100 has a similar form to that illustrated in the first embodiment, with the exception that there is no mixing tube 28 and accordingly the adjustment mechanism adopts a different form. In this second embodiment, the adjustment mechanism takes the form of an adjustment pin 128.

The adjustment pin 128 is located within the valve body 12 of the thermostatic mixing valve 100 so that it extends substantially perpendicularly to the longitudinal axis of the thermostatic element 26. The adjustment pin 128 has an inner portion 128a which is arranged to contact with the trailing end 26b of the thermostatic element 26. The adjustment pin 128 also has an outer end 128b which is accessible from the outside of the valve body 12 of the thermostatic mixing valve 100. The pin 128 is configured and arranged within the valve body 12 so that rotation of the adjustment pin 128 results in movement of the thermostatic element 26 either towards or away from the hot fluid inlet 16. This movement of the thermostatic element 26 results in a related movement of the piston 22 within the valve body 12 in a similar manner to that described previously above in relation to first embodiment of the invention.

As shown in Figures 2 and 3, the outer end 128b of the adjustment pin 128 is arranged to receive an allen key, screwdriver, tool or the like which enables ready rotation of the adjustment pin 128. Alternatively, the adjustment pin 128 may be slideable in a direction perpendicular to the longitudinal axis of the thermostatic element 26 and configured so that movement of the adjustment pin 128 will cause movement of the thermostatic element 26 in a direction towards or away from the hot inlet 16. In this manner the rest position of the thermostatic element 26 can be varied and thus the set temperature of the outlet fluid varied.

The mixing valve 100 shown in Figures 2 and 3 is particularly advantageous because the adjustment mechanism 128 of the valve 100 can be easily adjusted once the mixing valve 100 is installed. Adjustment can be achieved simply and quickly.

Figure 4 illustrates a "T" pattern thermostatic mixing valve 200. The mixing valve 200 includes a valve body 212, a cold fluid inlet 214, a hot fluid inlet 216 and a mixed fluid outlet 218. The valve 200 also includes a piston 222, a mixing

tube 224, a thermostatic element 226, a spring 234 and an adjustment mechanism 250.

The thermostatic element 226 is mounted in the mixing tube 224 and has a first end 226a in contact with the adjustment mechanism 250. The spring 234 is arranged to bias the mixing tube 224 towards the adjustment mechanism 250.

The piston 222 is mounted to the thermostatic element 226 so that movement of the thermostatic element 226 causes movement of the piston 222 within the bore of the valve body 212.

Fluid flow through the cold inlet 214 into the valve body 212 is throttled as the second end 222c of the piston 222 approaches a seat 246 (cold seat) formed in the valve body 212. Cold fluid flow into the mixing tube 224 will be prevented when the second end 222c of the piston 222 presses firmly against the seat 246 formed in the valve body 212 (the cold seat).

Fluid flow through the hot inlet 216 into the valve body 212 is throttled as a first end 222b of the piston 222 slides towards an elongate portion 212a (the hot seat) of the valve body 212. Hot fluid flow will be prevented when the second end 222b of the piston 222 comes into sliding contact with the portion 212a thereby blocking off the fluid flow path into the mixing tube 224. Limited continued expansion of the thermostatic element 226 is accommodated by continued sliding movement of the piston 222 along the portion 212a of the valve body 212 ("slide through" hot seat). Elongate portion 212a of the valve body 212 extends in the direction of movement of the piston 222.

The adjustment mechanism 250 is a threaded member which can be rotated so as to push the thermostatic element 226 against the bias of the spring 234. This results in a change in the rest position of the thermostatic element 226 and consequently a change in the positioning of the piston 222 relative to the cold and hot seats. Accordingly, the set temperature of the mixed fluid passing through the fluid outlet 218 is varied.

The described embodiments of the invention are considered to be particularly advantageous because they enable the set temperature of the outlet fluid of the thermostatic mixing valve to be readily varied, whilst minimizing any additional components or manufacture costs. It will also be appreciated that in the event that the thermostatic element continues to expand, the "slide through" hot seat arrangement of the various embodiments will absorb any over travel of the thermostatic element.

The embodiments have been described by way of example only and modifications within the spirit and scope of the invention are envisaged.

The discussion of the background to the invention herein is included to explain the context of the invention. This is not to be taken as an admission that any of the material referred to was published, known or part of the common general knowledge in Australia as at the priority date of any of the claims.